FURTHER OBSERVATIONS ON THE FLYING-FOX (*PTEROPUS GIGANTEUS* BRÜNN.) AND THE FULVOUS FRUIT-BAT (*ROUSETTUS LESCHENAULTI* DESM.).

BY

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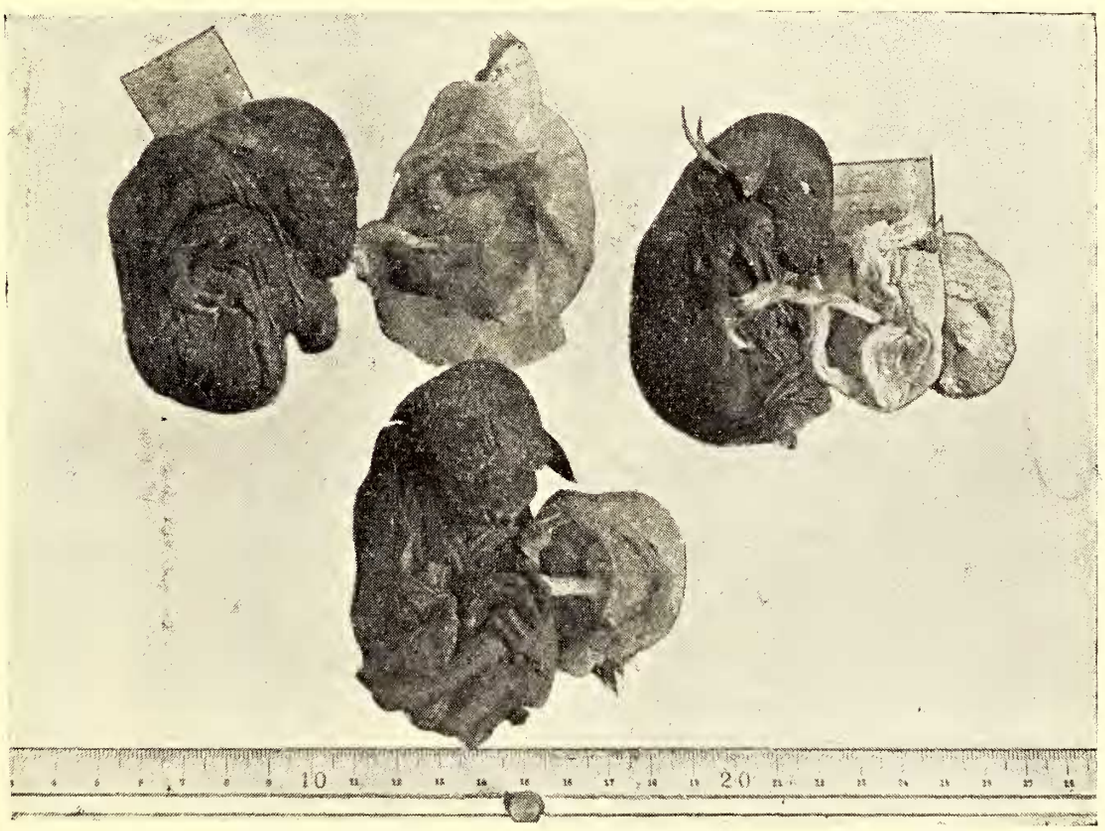
(*With* 1 *photo and* 1 *text-figure*).

In volume xxxvii, p. 143, of the Society's *Journal,* I dealt with some of the phases in the life-history of the Flying-Fox (*P. giganteus*); but animal life-histories are rarely, if at all, exhaustive, and my observations were far from complete. I now add a few more links to the chain.

On the 25th January (1941) I witnessed a couple in copulation at the Victoria Gardens roost, Byculla, at about 4 p.m. One approached the other from a neighbouring branch, as soon as the ventral surfaces were juxtaposed copulation ensued. The wings took no part in the hold. There was some squeeling, the act was brief, and the pair separated.



Foetuses of the Flying-Fox (*P. giganteus*). The top specimen on the left shows the correct position.

On the night of the 22nd February I shot some Flying-Foxes visiting the flowers of the Silk Cotton Tree (*Bombax Ceiba* L.) at Andheri. Among them were two gravid females, each containing a single foetus. At a rough estimate I would suggest that these two foetal specimens were about two weeks from full time. The skin was deeply pigmented and had a coating of short hair. This

clearly indicated that the young are not born naked. On the 26th (February) I secured another foetus of about the same age. The foetal specimens were large; measured within the foetal membranes they were approximately 76 x 54 mm. The back and neck were strongly arched and the long axis of the head was almost parallel with that of the back. The 'wrists' of both the wings rest on the neck just behind the right ear. The forearms pass obliquely across the body to the lower left side, one 'elbow' being hidden in the folds of the lower membranes; the other, the left, being exposed a little below the snout. The pollex or 'thumb' of the left wing is exposed below the toes, the other is hidden. The chin rests in the V formed by the forearm and the upper arm (humerus) of the left wing. The feet are gathered up, the right being hidden under the membranes of the wings. The left foot lies exposed on the right side, partially over the left forearm. The knee of the right leg is prominent, but the left is hidden from view. The ear of the right side is folded backwards; the left forwards. The umbilical cord passes out at the bottom of the V formed by the fore- and upper-arm. A comparison of the foetuses of the Flying-Fox and the Fulvous Fruit-Bat (*R. leschenaulti*) show that the position of the foetus of these two bats within the foetal investments is totally different. A short description of the position of the foetus of *Rousettus* will be found in my article on the Fulvous Fruit-Bats (*Journ. Bomb. Nat. Hist. Soc.* vol. xli, p. 813.).

On the 27th February, my son, Carl., found an adult *Pteropus* electrocuted on the mains. He got it down and to his surprise found a recently born young one clinging to the putrifying body of its mother. It was still alive and apparently uninjured. On examination I found the umbilical cord still adhering, but quite dry. The little fellow called frequently, a quaint, though loud call, quite unlike anything I have heard the adults produce. Though it baffles description, the call may be likened to the noise made by rapidly twisting a glass stopper in the neck of a bottle! My boys were anxious to try and rear it, so I allowed them the pleasure. Four days later the cord dropped off. The young bat fed on milk administered through a pipette and appeared to be thriving, but it died on the 5th March. On the day of its capture, its wing-span measured 450 mm.; the fore-arm 72 mm.

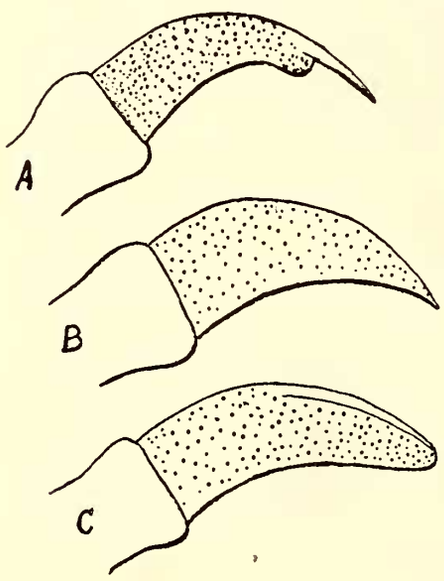


Fig. 1.—A. Claw of newly-born young,
B. ,, adult
C. ,, foetus.

While handling the little creature I noticed that the claws were extremely sharp and that they punctured the skin very readily. I examined the claws with a strong lens and soon discovered the reason for this. The claws were deep brown except the tips which were almost white and provided with extremely fine-pointed cusps. For the sake of comparison, I examined the claws of adults. The

claws were sharply pointed, but the cusps were entirely absent (see figures). The cusps in the young undoubtedly serve as a means of securing a firm hold on the body of the parent. The general tone of the fur was darker than in the adults; the wings and other naked portions of the body were a deep brown. The eyes were black and beady. The large size of the feet was remarkable. A peculiar odour hung about the animal. It clung well to branches and wire mesh, and there was little danger of it ever falling. It never moved about much, but when it was in difficulties it began to squeel.

These observations confirm my suggestion that the majority of births occur in March. The high birth rate at that time of the year in our area coincided with the greatest food supply for the parents, for it is the time when most trees are in bloom, a suitable period for nectar feeding animals. All males shot at this period clearly indicated that the breeding season was over as the testes were in a quiescent condition, and were not at all visible externally. During the breeding season the organs are pronounced.

In the breeding season one would expect the animals to be in the pink of condition, both internally and externally, but this does not always appear to be the case. One of the females, containing a well-developed foetus, was partially naked. The entire head and the greater part of the body were completely devoid of fur. The naked skin was a polished blackish brown, but to me, showed no signs of disease. In spite of this outward defect, she was well provided with fat internally. The foetus appeared as healthy and as well-developed as the others I had secured. I did not find any more parasites on this specimen than on the others—all were well supplied! The only ectoparasites I found on the bats were numerous spider-like wingless flies belonging to the family *Nycteribidae*[1], *Cyclopodea sykesi* Westw. These parasites are well known and have been recorded before from Flying-Foxes. So far I have not discovered any internal parasites visible to the naked eye.

In my previous article on these bats I referred to a number of food plants visited by them. To this I must now add the Cashu (*Anacardium occidentale* L.) and the Mango (*Mangifera indica* L.). The bats attack the fleshy pedicels of the *Cashu* on the verge of ripening for the sake of the copious juice. In previous years I had often noticed these bats hanging on mango trees during the flowering season, but at the time I did not suspect any association between the bat and the mango. This year, however, my curiosity was aroused by the litter of flowers and branches of the inflorescence lying on the road as I 'padded' my way to work. At first I could not explain this destruction, but it dawned on me that it might possibly be due to the work of bats; natural causes could not account for healthy flowers on the road. My suspicions aroused, I determined to watch the bats, and it was not long before evidence was forthcoming. I noticed that the animals clambered about the

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[1] I am indebted to Dr. B. Prashad for the identification.

inflorescences, and as they went detached part of the branches. At the same time, they appeared to be chewing, but what? I shot some and found that their mouths were crammed with mango blossom. Here then were the culprits. On dissection an examination of the stomach contents revealed that the stomachs contained only liquid and in the liquid microscopical fragments of petals, sepals, pollen, and fragments of the larvae of the Mango Hopper (*Idiocerus* sp.) and small *Diptera* which had passed unavoidably down with the nectar. It was now time to turn my attention to the mango flowers and learn a little more about them. Mango flowers open at dusk and a very copious amount of nectar begins to exude from the large nectaries. So plentiful is the exudation that it soon begins to drip like dew from a roof—this is what the bats are after, and, as the flowers are small, quantities have to be masticated. Any movement of the inflorescence, as for example, by the wind, causes the sprinkling of the neighbouring area with nectar. Though the bats destroy a considerable quantity of the blossom, yet sufficient escapes their attention to produce a good crop in good years when the blossom is not attacked by other enemies.

Incidentally, this year there was a bumper crop of mango bloom in Salsette, though all came to nothing—the crop has failed, but the bats were not responsible for this. As already indicated, the flowers produce a considerable quantity of nectar which drips like dew and is sprinkled on everything around. In some years the drip of nectar is excessive, and the trees and the ground below become coated with the sticky secretion. It forms a thin film over the foliage and the inflorescences. In the sun this film hardens and glistens. At night the heavy dew moistens it and is partly washed down, but fresh secretion from the flowers makes up for the loss. This goes on from day to day. The film of nectar forms a suitable culture for the development of a black fungus which soon spreads over the trees coated with nectar. In a short while the trees appear blackened as though charred or covered with soot. The local people refer to this condition as 'burnt' (*jul gāyā*). Actually the fungus masks the leaves and tender parts, thereby seriously obstructing the normal functions of the tissues. The inflorescences disintegrate soon after a covering of the fungus has appeared, and nothing is left, not even those flowers that 'set' fruit. It is the end of the mango crop for that year. As the weather becomes drier, the fungus film cracks and flakes off, and what remains is washed away by the rains. That the fungus is a result of an excessive secretion of nectar is borne out by the examination of isolated trees. Only the side or sides on which the blooms appear are affected by the fungus while the non-flowering portions remain unaffected. When trees are crowded and branches are interlocked, the entire trees are affected and these conditions perhaps assist largely in the spread of the disease[1]. When trees

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[1] The bats probably assist in the spread of the disease by carrying the fungus from one tree to another on their bodies.

are badly affected the whole tree and the ground below, protected by the circumference of the crown, is coated black.

Apart from the failure of the fruit crop, the trees actually suffer little damage from the fungus attack. The excessive exudation of nectar leads me to another point, namely, a local belief and practice. The locals annually hack a ring of deep incisions round the stem in the belief that this practice is instrumental in ensuring a good crop. The reason for this practice is the belief that by doing so they reduce the amount of sap reaching the young fruit which, if excessive, causes the fruit to drop soon after setting. How this belief arose is difficult to imagine, but perhaps the practice, if properly carried out without seriously injuring the trees, may truely help to reduce an excessive ascent of sap to the flowers, and thereby reduce an excessive nectar secretion. A consequent reduction in the danger of fungus growth might be the result. However interesting this subject, it is beyond the scope of this paper and I must return to the bats.

As the flowers of *Bombax* and mango became less the bats became fewer in proportion till finally they disappeared from the area. *Erythrina indica* and *E. stricta* now came into full bloom, but these blossoms were not visited by the bats. The flowers of *Erythrina* open towards morning and the greatest amount of nectar is produced during the hours of daylight, and are thus not suited for bat visitors. These flowers are chiefly pollinated by bird visitors and other diurnal animals. Strangely enough in the cases of *Bombax* and *Erythrina* we see trees with similarly coloured flowers—red—one adapted for nocturnal pollination and the other for diurnal pollination! The fact that *Bombax* is a night flowering plant is borne out by the fact that the buds open in the evening and the greatest amount of nectar is produced soon after. True the flowers keep open for a considerable time before they fall, and what pollination may have escaped the efforts of the bats, may be completed by the early birds and other visitors; but the chances of pollination by diurnal visitors is small. However, my casual observations on the fertilization of *Bombax* suggest yet another means, that the flowers are not merely adapted for cross-fertilization, but for self-fertilization also! I have examined numerous flowers at various times of day and night and I have been led to the conclusion that the outer bundles of stamens, forming a ring around the edge of the 'cup' of the flower, mature first and are shorter than the style. The bat visitors must first come in contact with the stigma before coming to the staminal ring where the muzzle becomes dusted with pollen and so on for each flower to effect cross-fertilization, as they attempt to get at the bottom of the cup for nectar. Besides this staminal ring there is another bundle of stamens surrounding the base of the style. At first this group of stamens is shorter than the style, the stigma is well above them. Later some stamens of this bundle begin to elongate and the anthers at the top of these stamens reach the same level as the stigma, this usually takes place the day after the opening. Failing cross-fertilization the stigma now stands a chance of self-fertilization by pollen from these lately elongated stamens.

Nature appears to take few chances and so provides for emergencies when the question of propagation is at stake ! I am aware of several cases in which there is this double provision. However, in spite of the time I have spent, and the many flowers I have examined, the observation must be taken with reserve until further light is shed on the subject. It is beyond the scope of this paper to discuss the values of cross- and self-fertilization, which belongs to another department of natural history.

Turning from the activities of the Flying-Foxes to those of the Fulvous Fruit-Bat (*R. leschenaulti*) which often feeds in company with its bigger relative, I have just a little to add to what I have already written in my article on this species in volume xli, p. 805 of the *Journal*. At the same time as I observed the Flying-Foxes feeding on mango flowers, *Rousettus* often came into the picture. Like *Pteropus, Rousettus* was also feeding on the mango blossoms. Many of the specimens were sticky with nectar and occasionally I saw some just hanging and licking themselves clean. Likewise *Rousettus* was feeding on *Bombax* and Cashu. They also fed on the fruit of *Mimusops hexandra* Roxb. During the flowering season of this tree these bats also visit it. The females secured were all gravid and contained well-developed foetuses. This period coincides with my former observations.

The fact that the breeding, or rather the birth, of *Pteropus* and that of *Rousettus* coincide, confirms the fact that the period is largely influenced, if not entirely governed, by the food supply of the parents when the nursing mothers require nourishing and sustained supply for the well being of themselves and their young. These further observations on the two bats confirm my belief that the fruit-bats are in reality nectar feeders and juice feeders, only eating such fruit entire which readily liquefy.

Though these bats feed on mango flowers, they evidently do not do as much damage to the crop as at first sight might appear to be the case, for in good years when the blossom is free from fungus and other attacks there is generally a bumper crop of fruit in spite of the attacks of the bats. Therefore I am not in favour of the destruction of the bats on this account. Their destruction may mean a great loss in some other direction yet unknown and unforeseen.